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Adaptive Oceanographic Sampling in a Coastal Environment Using Autonomous Gliding Vehicles

David M. Fratantoni

Department of Physical Oceanography
Woods Hole Oceanographic Institution

Woods Hole, MA 02543

phone: (508) 289-2908 fax: (508) 457-2181 email: dfratantoni@whoi.edu

Grant Number: N000140110340

<http://science.whoi.edu/users/dfratantoni>

LONG-TERM GOALS

Our long-term goal is to develop an efficient, relocatable, infrastructure-free ocean observing system composed of high-endurance, low-cost gliding vehicles with near-global range and modular sensor payload. Particular emphasis is placed on the development of adaptive sampling strategies and the automated control of large glider fleets operating within the framework of an autonomous oceanographic sampling network.

OBJECTIVES

The primary objective of this program is to demonstrate moderate-term (weeks) operation of a multi-vehicle network of autonomous gliders in a coastal environment. Secondary objectives include continued development of adaptive sampling strategies suitable for large fleets of slow-moving autonomous vehicles.

APPROACH

We will construct and operate a network of autonomous gliding vehicles in the Atlantic Ocean south of Martha's Vineyard. Three gliders will be used to characterize the three-dimensional, time-dependent structure of the shelfbreak front in the Mid-Atlantic Bight while simultaneously measuring physical and optical properties across the width of the New England continental shelf.

WORK COMPLETED

The main task completed was a complete redesign of the vehicle incorporating significant improvements in modularity and robustness. Major improvements include addition of a modular science payload bay with a dedicated computer system, integration of acoustic transducers in the bow cone for underwater communications, and addition of a servo-controlled rudder for improved lateral control. Three of these new generation vehicles has been delivered by the manufacturer (Webb Research Corp.).

We have completed the backbone of an integrated glider data management system. This system is now in routine use in our laboratory and has been linked with a web-based front-end for near-real-time data distribution via the internet and integration with assimilating numerical models. We have developed a

desktop-based mission simulator which allows efficient prototyping of adaptive sampling algorithms and multiple-vehicle interaction with arbitrary, realistic environmental forcing (winds, tides, currents, etc.).

Iridium is now the primary means of bidirectional vehicle-to-shore communications. Initial tests indicate that the system is robust and should enable truly global operation of autonomous glider networks.

RESULTS

Operations in Buzzards Bay with three electric vehicles during winter 2001-2002 yielded approximately 450 total hours of automated network operation resulting in nearly 8000 vertical profiles of temperature and salinity. A prototype environmental optics package (chlorophyll fluorometer, PAR, turbidity) was developed and tested.

IMPACT/APPLICATIONS

Continued development of adaptive multi-vehicle network operations will enable adaptive measurement of time-dependant or transient ocean phenomena such as mesoscale eddies and fronts, as well as generic distributed environmental observations in remote or hostile locations. A network of gliding vehicles will supply, in an efficient and cost-effective manner, high-quality, near-real-time environmental information for operational ocean/atmosphere forecasting and model validation.



Above: Redesigned electric glider. Major improvements include addition of a modular science payload bay (center section) with a dedicated computer system, integration of acoustic transducers in the bow cone for underwater communications, and addition of a servo-controlled rudder for improved lateral control.